LTG Joseph L. Yakovac Jr., Military Deputy/Director, Army Acquisition Corps, Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology, emphasizes a point in his keynote address on Light Combat System Survivability. All photos accompanying this article are by Larry Shank, Army Research Laboratory.

24th Army Science Conference Features Transformational S&T for the Current and Future Force

Dr. John A. Parmentola and Gene B. Wiehagen

The theme for the 24th Army Science Conference (ASC), *Transformational Science and Technology for the Current and Future Force*, highlighted the critical role of science and technology (S&T) in enabling Army transformation and helping to win the global war on terrorism. Held Nov. 29-Dec. 2, 2004, in Orlando, FL, the conference brought S&T professionals from industry, academia, the Army and other government organizations together to discuss the latest developments and emerging technologies and their impact on the Current and Future Force. This year's event was the first to accept papers and presentations from allied and coalition partners. More than 1,600 people from 30 different nations attended the conference.

Professor Neil A. Gershenfeld (Director, Center for Bits and Atoms, Massachusetts Institute of Technology) emphasizes points during his presentation on his new approach to deriving communication protocols for complex networks.

Seventy-five individual booths and numerous current warfighting systems covering the full spectrum of Army capabilities were on display. Through these displays, visitors were able to experience transformation via demonstrations from Force Protection, Logistics, Training and Simulation and Commander Centric Warfare programs. Products of these programs — such as medical innovations, Humvee armor kits and the Stryker Battle Command on the Move prototype — are making a significant difference for our Soldiers in Iraq. High-performance computing, immersive technology, nanotechnology and biotechnology initiatives were also displayed.

Keynote Speakers

A conference highlight was Acting Under Secretary of Defense for Acquisition, Technology and Logistics (AT&L) Michael W. Wynne's keynote address, which described DOD's goals for AT&L — acquisition excellence with integrity; an integrated and efficient logistics program; systems integration and engineering for mission success; achieving technology dominance; rationalization of resources; a strengthening of our industrial base; and the creation of a motivated and agile workforce. Wynne cautioned that "we must work together and create true interoperability among our own services and with our coalition partners as well … the single most vital warfighting technology for our military transformation is a true Joint battlespace management architecture."

Army Vice Chief of Staff GEN Richard A. Cody stressed that the Army's overarching goal is to remain relevant and ready across the range of military operations. He further reminded us that Soldiers remain the centerpiece of our units, and that they are the most effective, flexible and adaptable asset we possess — the Army's best sensor, the face of the United States overseas and a reflection of our Army Values. Conference host and Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASAALT) Claude M. Bolton Jr. described how the S&T and acquisition communities are spiraling capabilities directly from the technology base to the Current Force to put available technologies and capabilities into Soldiers' hands now. He stated that "by 2014 … the better part of the Army [will] have at least some portion of what the Future Combat Systems (FCS) will have and one entire Unit of Action will have all the technology." Dean Popps, Principal Deputy ASAALT, provided an update on rebuilding and construction activities in Iraq, from where he had recently returned.

Professor Lui Pao Chuen, Chief Defence Scientist, Singapore Ministry of Defence, emphasizes the need to recruit and retain the best and brightest technologists for the future.

Other Presentations

Mike Markin, Officer of the Order of the British Empire and United Kingdom (U.K.) Ministry of Defence S&T Director, provided an international perspective for conference attendees. He discussed the contributions of S&T to the current operations in Iraq and Afghanistan, the U.K.'s migration to a "network-enabled capability" and his desire to achieve transformation and coalition interoperability through international research and technology alliances.

Jim Albaugh, President and Chief Executive Officer (CEO), Boeing Integrated Defense Systems, noted that the "capability requirements desired by leaders from Alexander to Patton have not changed and are still the objectives of technological improvements. These requirements are superior speed and mobility, situational awareness, integrated command and control." He stated that the FCS program has already transformed the way industry meets warfighters' needs and pointed out that the Lead Systems Integrator concept is a style that focuses on

LTC Chessley Atchison demonstrates the Chitosan dressing to LTG Claude V. Christianson, Deputy Chief of Staff, G-4, U.S. Army, and Jill H. Smith, Director of the Weapons and Materials Research Directorate, U.S. Army Research Laboratory.

optimization at the systems level versus the platform level, and demands the best industry solutions and innovations from around the world.

The first day's speeches concluded with Deputy Assistant Secretary of the Army for Research and Technology/Chief Scientist Dr. Thomas H. Killion's presentation on creating future S&T for Soldiers and Kurzweil Technologies Inc. founder and CEO Ray Kurzweil's extraordinary vision of the future out to 2050, which he sees being dominated by paradigm shifts resulting from developments in genetics, nanotechnology and robotics. He predicted that the human brain would be reverse engineered by 2029 and that silicon-based computing would reach levels equivalent to all human brains on the planet by 2050.

Second Day's Events

The second day focused on Network Centric Warfare and the enabling technologies. Edward M. Siomacco, Director of Technology, Office of the Army Chief Information Officer, G-6, opened the day addressing the need for streamlined network-enabled modular organizations linked to Home Station Operations Centers to minimize forward footprints. These organizations would be capable of commanding or supporting Joint and multinational, as well as Army, forces. He explained how today's Web has changed the way we do business but that information is difficult to find, stovepiped, perishable and hard to transform into actionable knowledge. A Semantic Web that is intelligent, interoperable and has enduring information would improve data discovery and enable enterprise integration, network-centric warfare and much more advanced knowledge management. He also presented a vision for LandWarNet, described as the Army's contribution to the Global Information Grid, that enables integrated

Nobel laureate Dr. Alan J. Heeger, University of California, Santa Barbara, speaks on risk and innovation in science.

applications, services and network transport across the warfighting and operational support domains.

A panel discussion on commander-centric warfare followed Siomacco's presentation. Panel chair BG Phillip Coker, U.S. Army Training and Doctrine Command (TRADOC) Futures Center, stated that the goal of commander-centric warfare is to provide a common vision of the commander's intent, assured communications under all conditions, a robust information network to ensure the transport of critical information, the ability to conduct operations at all levels and enhanced situational awareness that leads to actionable situational understanding.

The next panel focused on network science and emphasized the criticality of internetted command, control, communications, computers, intelligence, surveillance and reconnaissance to FCS. The panel recommended that the Army substantially increase research aimed at integrating control, computer science, communications and networking, and move toward enterprise-level systems while exploring more high-risk, long-range applications of control to areas such as nanotechnology, quantum mechanics, electromagnetics, biology and environmental science. They also recommended investing in new approaches to education and outreach for the dissemination of control concepts and tools to nontraditional audiences.

Lui Pao Chuen, Chief Defence Scientist, Singapore Ministry of Defence, was the luncheon speaker. He emphasized the need to prepare both warriors and engineers for the future force and described Singapore's strategy for attracting and retaining the best and brightest college graduates for military and civil service. He articulated a thought-provoking simile to characterize future network-centric warfighting: Rather than think of a brigade as a symphony orchestra with a conductor

CPT Ben Johnson, TARDEC, operates the crew automation testbed for BG(P) Roger Nadeau, Commanding General, U.S. Army Research, Development and Engineering Command, and BG Peter Holt, Department of National Defence Canada. This is a joint U.S.-Canada collaborative experiment looking at interoperability issues.

Dr. Thomas H. Killion, Deputy Assistant Secretary for Research and Technology/Chief Scientist, gains appreciation for the rapid prototype updates for Stryker Battle Command on the Move from John Schmitz.

to lead it, think of a brigade as a small jazz combo that rapidly improvises and adjusts in real time to battlefield situations.

Third Day's Events

LTG Joseph Yakovac Jr., ASAALT Military Deputy and Army Acquisition Corps Director, started the third day by addressing the challenges in achieving survivability for light-combat systems and how this requires a radical change in our approach to survivability. He focused on the enormous complexity of FCS and the need to integrate the numerous component parts from the Army's diverse materiel development community to fulfill FCS requirements. He also emphasized that the Army isn't currently configured to do this in a consistent and efficient manner.

A force protection panel discussed current research aimed at preventing or mitigating hostile actions against Army personnel, resources, facilities and critical information. COL Brian Lukey, Army Medical Research and Materiel Command, emphasized that solutions to problems must not increase health risks, not even long-term risks, and their goal is to consider the Soldier's health throughout the entire cycle from recruitment through retirement.

A logistics panel provided an overview of the complex logistics operations that support *Operation Iraqi Freedom*, including lessons learned. What the logisticians need from the S&T community are new technologies that provide better visibility of requirements and a common view of the battlefield, enable rapid and precise responses, reduce consumption, increase force protection and improve maintainability.

Luncheon speaker COL(P) Mark Graham, Deputy Commanding General, U.S. Army Field Artillery Center and Assistant Commandant, U.S. Army Field Artillery School, Fort Sill, OK, spoke of the Institute of Creative Technologies' (ICT's) Joint Fires and Effects Training System prototype. He emphasized the important role this state-of-the-art mixed reality environment — which incorporates virtual humans, gaming technology and adaptive opponents — plays in the future training of Soldiers.

Graham's speech set the tone for the training and simulation panel, which focused on the need for a virtual environment that supports training, planning and mission rehearsals. The virtual environment would make Soldiers feel like they were in combat situations, and would include an asymmetric combat environment. Teammate and adversary human behavior representation, adequate fidelity/immersion of subjects, rapid terrain/scenario generation and the ability of intelligent tutoring systems to make dynamic assessments and provide automated feedback and remediation are significant challenges in making such a tool truly effective and useful.

Final Day's Events

On the conference's final day, Neil Gershenfeld, Director of the Center for Bits and Atoms, Massachusetts Institute of Technology, gave a presentation on a new approach to deriving communication protocols for complex networks. He discussed his laboratory's studies on fundamental mechanisms for manipulating information and how he and his colleagues integrate these ideas into everyday objects such as furniture and automobile safety systems. He showed how they collaborate with partners to apply the same techniques in systems as disparate as a computerized cello for Yo-Yo Ma and a wireless radio network for nomadic Arctic herders to track reindeer.

Two panels addressing miniaturization and complexity followed Gershenfeld's presentation. The miniaturization panel provided evidence pointing to the end of Moore's Law — the observation that data density doubles every 18 months — within the next 15 years and discussed the implications to Army systems that depend on superior computers. Post-Moore's Law technologies include molecular electronics, biologically inspired computing and quantum computing. The presentation's key points were that processor ubiquity is the basis of the digitized battlefield, and technologies based on processing superiority must be questioned if everyone has the same processors. Furthermore, we have to use our resources more smartly and efficiently while recognizing threats to information security.

The complexity panel addressed questions regarding the science of complexity

and how it might eventually replace the separate disciplines of biology, chemistry, economics, physics and sociology. They cited previous statements from other panels and keynoters as examples of complexity. These included modularity; the Semantic Web; a large number of interconnected network systems; highly constrained, uncertain, large-scale, nonlinear, multiscale networks; and the lack of mathematical formalism, particularly for wireless networks.

The speaker for the awards luncheon was Dr. Alan Heeger, Nobel laureate, University of California at Santa Barbara. He gave an entertaining and personal talk on risk and innovation in science, describing how winning the Nobel Prize in Chemistry has affected his life and influenced both his and his colleagues' work. He cautioned that doing good science requires both good taste and good judgment in evaluating risk versus reward. This perfectly prefaced the 2003 and 2004 Research and Development Achievement Awards, in which more than 200 winners were recognized for their Army S&T work at the 24th ASC Awards Banquet.

Best Paper Awards

Killion presented the 24th ASC Best Paper Awards to the authors of 15 outstanding technical papers, selected for original subject matter, logical organization, clarity and conciseness, technical merit and significance to the Army.

Scientific peers deemed three papers as representing the highest quality research presented at the conference. Authors of two of these papers received bronze medallions, while the authors of the paper judged the overall best in Army research received the Paul A. Siple Memorial Award.

The winners of the 24th ASC Paul A. Siple Memorial Award were Laszio J. Kecskes, Brian T. Edwards and Robert H. Woodman from the Weapons and Materials Technology Directorate, U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD, for their paper titled *Hafnium-Based Bulk Metallic Glasses for Kinetic Energy Penetrators*.

The first bronze medallion was awarded to Dr. Gordon R. Johnson, Dr. Stephen R. Beissel, Dr. Charles A. Gerlach, Dr. Robert A. Stryk, Dr. Andrew A. Johnson and Timothy J. Holmquist, Network Computing Services Inc., for their paper *Advanced Computations for Ballistics Impact Problems*.

The second bronze medallion went to Dr. Richard K. Gordon, Dr. Julian R. Haigh, Dr. Gregory E. Garcia, Dr. Shawn R. Feaster, Dr. Bhupendra P. Doctor from the Walter Reed Army Institute of Research; COL Michael A. Riel from the Uniformed Services University Health Services; CPT Lee J. Lefkowitz from the U.S. Army Center for Health Promotion and Preventative Medicine; Dr. David E. Lenz from the U.S. Army Medical Research Institute of Chemical Defense; Dr. Paul S. Aisen from Georgetown University; and Dr. Wilson Smart from Kumetrix Inc., for their paper titled *Whole Blood Robotic Cholinesterase Assay for Organophosphate Exposure — Testing Soldiers, First Responders, and Civilians in the Field and Laboratory*.

The other 12 papers selected were:

Dr. Heesung Kwon and Dr. Nasser Nasrabadi, ARL, for their paper *Kernel-Based Anomaly Detection in Hyperspectral Imagery*.

Jeff Hoppe, Daniel Duvak and George Palafox, U.S. Army Communications-Electronics Command Research, Development and Engineering Center, for their paper *Antenna Optimization Study on Stryker Vehicle Using FDTD Techniques*.

Dr. Kevin Massey, Dr. Jim McMichael, Tyler Warnock and Frank Hay, Georgia Institute of Technology, for their paper *Design and Wind Tunnel Testing of Guidance Pins for Supersonic Projectiles*.

Dr. Nicolas Vandapel and Martial Hebert, Carnegie Mellon University, for their paper *Finding Organized Structures in 3-D LADAR Data*.

Edward F. O'Neil, Toney Cummins, Bartley Durst, Pamela Kinnebrew, R. Nicholas Boone and Ricardo Torres for their paper *Development of Very-high-strength and High Performance Concrete Materials for Improvement of Barriers Against Blast and Projective Penetration*.

Dr. Peter Shih, John Tasdemir and Dr. Walter Bryzik, U.S. Army Tank-Automotive Research, Development and Engineering Center, for their paper *Determination of Laminar Flame Speed*

Weston Moyers from the U.S. Army Communications-Electronics Research, Development and Engineering Center Command and Control Directorate (left) explains the principle behind the hand-held generator to Dean G. Popps, Principal Deputy ASAALT.

Dom Pickard from the DOD Combat Feeding Directorate explains the operation of the Field-Feeding and Advanced Sustainment Technology Food Service equipment to LTG Claude V. Christianson, Deputy Chief of Staff, G-4.

of Diesel Fuel for Use in a Turbulent Flame Spread Premixed Combustion Model.

Jarrell Pair, Dr. Anton Treskunov and Dr. William Swarthout, University of Southern California's ICT, for their paper *The Flatworld Simulation Control Architecture (FSCA): A Framework for Scalable Immersive Visualization Systems*.

Dr. Gary Kamimori, Dagny Johnson, COL Gregory Belenky, Walter Reed Army Institute of Technology; and Dr. Tom McLellan and Doug Bell, Defence Research and Development, Canada, for their paper *Caffeinated Gum Maintains Vigilance, Marksmanship, and PVT Performance During a 55 Hour Field Trial*.

Dr. Rasha Hammamieh and Dr. Marti Jett, Walter Reed Army Institute of Research, for their paper *Global Gene Expression Analysis to Unambiguously Identify Host Gene Responses Characteristic of Exposure to Biothreat Agents*.

Dr. Arjan Giaya, Apoorva Shah, Dr. Bryan Koene and Erin McLaughlin, Triton Systems Inc.; and Kristian Donahue and Jean Hampel, U.S. Army Natick Soldier Center, for their paper *Nanocomposite Barrier Fabric for Chemical and Biological Agent Resistant Tent*.

Dr. Weimin Zhou, Dr. Steven Weiss and Dr. Christian Fazi, ARL, for their paper *Developing RF-Photonics Components for the Army's Future Combat Systems*.

Dr. J. Michael Cathcart, Dr. Robert D. Bock and Richard Campbell, Georgia Institute of Technology, for their paper *Analysis of Soil and Environmental Processes on Hyperspectral Infrared Signature of Landmines*.

Dr. John A. Parmentola, the 24th ASC Master of Ceremonies, concluded the event by quoting well-known medical doctor and researcher, Dr. Lewis Thomas: "We need reminding, now more then ever, that the capacity of medicine to deal with infectious disease was not a lucky fluke, nor was it something that happened simply as a result of the passage of time. It was the direct outcome of many years of hard work, done by imaginative and skilled scientists, none of whom had the faintest idea that penicillin and streptomycin lay somewhere in the decades ahead. It was basic science of a very high order, storing up a great mass of interesting knowledge for its own sake, creating, so to speak, a bank of information, ready for drawing on when the time for intelligent use arrived."

Remarks from conference attendees indicated an overwhelming consensus that the 24th ASC was the best ever. It enabled the Army to showcase major research, technologies and systems relevant to the Current and Future Force and its efforts to win the global war on terrorism. In addition to including our international and coalition partners, this year's conference also included several Junior Science and Humanities Symposium winners, who presented their papers in appropriate technical sessions, and recognized a group of eCybermission students in the opening ceremonies. It is hoped that exposing these young adults to the Army's needs and technical challenges will motivate them to continue their pursuits in science, mathematics and engineering.

CAPT Angus Rupert, MC, USN, (left), explains the Tactical Situation Awareness System to Dean G. Popps, Principal Deputy Assistant Secretary of the Army for Acquisition, Logistics and Technology.

The venue, luncheons, banquets and entertainment provided by the U.S. Army Field Band, 389th Army Band, Army Chorale and the Army Old Guard were all outstanding. The special efforts of the Army's S&T community and the support provided by the Army Materiel Command, ARL, Army Research Institute, TRADOC, Army Special Operations Command, Army Corps of Engineers, MRMC and Army Space and Missile Defense Command were essential in making this an extraordinary event.

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